Work-in progress DRAFT from SCE   for discussion with the VGI working group   Also see utility comments on the straw proposal scope

Work Plan for Vehicle-Grid Integration Communications Protocol Working Group
CPUC, CEC, CARB, CAISO Staff

Background and Summary:
Per feedback gathered in advance of and during the April 24 Launch Meeting of the VGI Communications Protocol Working Group ("Working Group", WG), the interagency staff has revised the structure of the Straw Proposal. Major revisions to the approach are multi-fold:

a. To avoid attempting to address issues less germane or tangential to the agencies' jurisdictional authorities within the limited timeframe.
b. To focus and segment the scope of work to answer the:
    a. CPUC's questions relating to engineering design and functionalities of charging infrastructure equipment proposed for ratepayer funding under the investor-owned utilities' SB 350 applications.
    b. Broader policy, valuation, and business-model considerations potentially barring VGI market development
c. To map the Straw Proposal questions to the State's existing statements developing VGI policy and technology
d. To propose a more precisely defined trajectory of Working Group meetings to enable more efficient discussions considering travel, efficacy of online conferences, and deliverables from active participants and interests.

Required Reading and Supporting Documentation:
- Foundational Documents
    o CPUC Energy Division, Vehicle-Grid Integration: A Vision for Zero-Emission Transportation Interconnected throughout California's Electricity System, 2013. ("VGI Whitepaper")
    o CAISO et al., California Vehicle-Grid Integration Roadmap: Enabling vehicle-based grid services, 2014. ("VGI Roadmap")
    o CPUC, Appendix B to the Assigned Commissioner Ruling Regarding the Filing of Transportation Electrification Applications Pursuant to Senate Bill 350, 2016 ("Appendix B")
    o CEC and CPUC Joint Workshop, Vehicle-Grid Integration Communications Standards – Interagency Presentation, 2016
    o CEC, Annual Multi-Agency Update on Vehicle-Grid Integration Research, 2014, 2015, 2016
    o SMUD - various presentations and studies on VGI benefits and costs (full list to be provided later)
        - SAE 2014-01-0344: Electric Grid Integration Costs for Plug-in Electric Vehicles: Jeff Berkheimer, Jeff Tang, Bill Boyce, Deepak Aswani, SAE International Journal of Alternative Power, 3(1), 2014, doi: 10.4271/2014-01-0344
        - EVS29 EPRI's 'Hotspotter' Tool: Identifying Potential Utility System Overloads in a Growing EV Market: Jamie Dunkley, Deepak Aswani, Arindam Maitra, Jason Taylor, Rajesh Radhakirishnan, Dwight MacCurdy.
        - Bill Boyce Presentation on April 18, 2016 to the CEC's IEPR / IRP workshop
    o Vehicle-Grid Integration Communications Protocol Working Group, CPUC and CEC Staff Straw Proposal, 2017 ("Straw Proposal")
    o EPRI presentation, Dec 2016 at interagency workshop (e.g., lists 24 guiding principles expanding on Appendix B)
    o CPUC submetering effort
    o ElaadNL, EV Related Protocol Study, 2017 ("Protocol Study") – for European architecture and protocol reference purposes only.
    o SAE Standards / Technical Information Reports / Recommended Practices

- J2836/1, Use Cases for Communication Between Plug-in Vehicles and the Utility Grid
- J2847/1 Communication between Plug-in Vehicles and the Utility Grid
- J2836/2,Use Cases for Communication Between Plug-In Vehicles and Off-Board DC Chargers
- J2847/2 Communication Between Plug-In Vehicles and Off-Board DC Chargers
- J2836/3 Use Cases for Plug-In Vehicle Communication as a Distributed Energy Resource
- J2847/3 Plug-In Vehicle Communication as a Distributed Energy Resource
- J2931/1 Digital Communications for Plug-in Electric Vehicles
- J2931/4 Broadband PLC Communication for Plug-in Electric Vehicles
- J3072 Interconnection Requirements for Onboard, Utility-Interactive Inverter Systems

http://www.sae.org/search/?qt=j2836%2F1&sort=relevance&sort-dir=desc&display=list&content-type=%28%22STD%22%29

- o IEEE 2030.5 IEEE Adoption of Smart Energy Profile 2.0 Application Protocol Standard - https://standards.ieee.org/findstds/standard/2030.5-2013.html
- OpenADR 2.0b Specifications - https://standards.ieee.org/findstds/standard/2030.5-2013.html
- o
- NIST IR 7628, volumes 1, 2 and 3 - http://csrc.nist.gov/publications/nistir/ir7628/nistir-7628_vol2.pdf
- o
- California Smart Inverter Working Group (SIWG) and California Smart Inverter Profile (CSIP) documents and recommendations California Smart Inverter Profile of IEEE 2030.5- http://sunspec.org/ieee-2030-5-common-california-iou-rule-21-implementation-guide-smart-inverters/
- o
- o EPRI Public Documents:
  - Open Vehicle-Grid Integration Platform: General Overview Product ID 3002008705
  - Open Vehicle-Grid Integration Platform: Systems Approach to Standards and Interoperability Product ID: 3002008866,
  - Open Vehicle-Grid Integration Platform – Unified Approach to Grid / Vehicle Integration: Definition of Use Case Requirements Product ID: 3002005994

    https://www.epri.com/#/search/Open%20Vehicle-Grid%20Integration%20Platform:%20General%20Overview/?to=1483020750731&from=1310345249268

- o NIST/SGIP Catalog of Standards - http://collaborate.nist.gov/twiki-sggrid/bin/view/SmartGrid/SGIPCoSSStandardsInformationLibrary

- Key Terms and Definitions
  - o ElaadNL Protocol Study Section 1.4 – not applicable to the US utility industry
  - o VGI Roadmap Appendix E (some of these terms need refinement)
  - o (Additions to be developed by stakeholders as needed) utilities are still working on glossary of terms (list below is partial and without

Work-in progress DRAFT from SCE   for discussion with the VGI working group   Also see utility comments on the straw proposal scope definitions)

- VGI types
  - Charging level incentives
    - (tools include rebates for lower level charging, modifying current allowance policy, demand charge design)
  - Managed Charging
    - Tools include TOU rate design, TOU rate adoption, DR programs at the charging station, kiosk, or circuit level
  - V1G wholesale market services provided by unidirectional power flow enabling vehicles to charge including varying the charge rate
  - V2G
- VGI benefit groupings (modified from DOE – EPRI 2013 Energy storage handbook
  - **Wholesale market services**: 1) frequency regulation, 2) spinning, non-spinning and supplemental reserve, 3) load following / ramping support for renewables
  - **Distribution infrastructure benefits**: 1) avoided cost of   distribution upgrade deferral 2) voltage support
  - **Customer facing benefits:** 1) retail energy time shift, 2) demand leveling 3) power quality, 4) power reliability, 5) monetizing of GHG and air pollution reduction benefits

  o As defined in the SAE, NIST, SIWG and CSIP documents above

Expectations for Active Participants Contributing to Products/Deliverables:

- The Working Group expects that subgroups will form to assist in the development of material needed to answer the questions identified below and use the foundational documents to avoid duplication of prior work. The Facilitator will assist these subgroups in establishing a reasonable and timely review process to determine the level of agreement among stakeholders for delivered products.

Stakeholder Viewpoints to be Examined

   i.   EV user (driver/rider)

  ii.   Electric Vehicle (EV) Original Equipment Manufacturer (OEM)

 iii.   Distribution System Operator (DSO or Utility) and Independent System Operator (ISO)

 iv.   Electric Vehicle Service Provider (EVSP) ~~or E Mobility Service Provider (EMSP)~~

  v.   VGI Resource Aggregator ~~or other Market Participant~~

 vi.   Non-Participating Ratepayer or Society

~~The interagency staff recommends using Figure 16 from the ElaadNL Protocol Study to group the examination of protocols per the following Deliverables~~
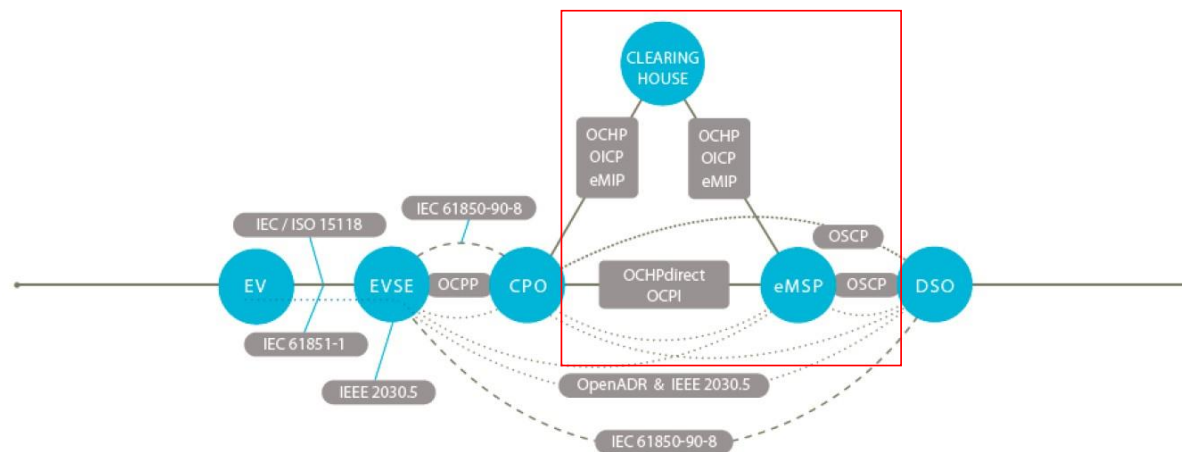

Figure 16: overview of protocols and market roles

This is how it works in Europe, not the US. Suggested Changes to make sense for the US and CA market:

> **Comment [DT1]:** Recommend deleting this figure and replacing it with the new figure below which is much simpler and appropriate for the US situation.
>
> Figure 16 show how things may work in Europe, not in the US.

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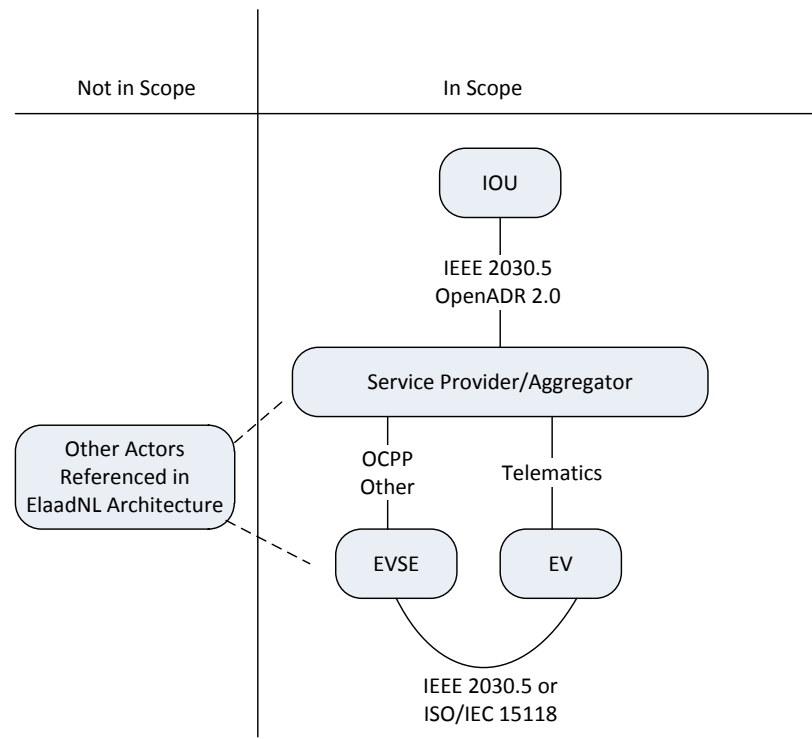*-The red box should not be in scope of this work. That is a market function.*
-The OpenADR & IEEE 2030.5 interface goes to the CPO (which should be renamed to Service Provider/Aggregator).
-Any references to 61850 should be removed.
-61851 bubble should read SAE J2847/1 & J2847/3. ---Need to add an interface between renamed CPO bubble and EV bubble labeled Telematics

Alternative VGI Infrastructure Connectivity Representation

Not in Scope	In Scope

```
                                    ┌──────┐
                                    │ IOU  │
                                    └──────┘
                                       │
                                  IEEE 2030.5
                                  OpenADR 2.0
                                       │
                          ┌─────────────────────────────┐
                          │  Service Provider/Aggregator │
                          └─────────────────────────────┘
                               │                 │
   ┌─────────────────┐       OCPP           Telematics
   │  Other Actors   │       Other
   │  Referenced in  │         │                 │
   │ ElaadNL Architecture│   ┌──────┐        ┌──────┐
   └─────────────────┘     │ EVSE │        │  EV  │
                           └──────┘        └──────┘
                               └──────┬───────┘
                                 IEEE 2030.5 or
                                 ISO/IEC 15118
```

Deliverable Workstream 13: Value Proposition and Enabling Policy
Deliverable 1: Develop Glossary, Guiding Principles, Value Proposition, VGI Use Cases and other Solutions
  a.   Develop glossary of terms
  b.   Develop guiding principles using the ACR's Appendix B as a starting point
  c.   Develop VGI use cases and solutions to address wholesale market, distribution infrastructure and EV driver needs
  d.   Understand the values that each group of VGI applications (wholesale market, distribution infrastructure, value to customer or driver) can address and prioritize these groups (note terms - Based on DOE-EPRI Storage Handbook definitions)
  e.   Use guiding principles to validate use cases; determine value / business case for each use case
  f.   Determine timeframes for required implementation of the use cases or non-market solutions
  g.   Answer additional questions/tasks 1-11, 12, 14, 15, 18, 19 (from the utility modified straw proposal).
Deliverable 2: Market Policy Actions and Recommendations
  a.   What market or policy actions do stakeholders recommend to more appropriately value, procure, or put into operation VGI resources and use cases? Answer tasks 19, 20, and 21 in utility modified straw proposal
Deliverable 3: Pilots and Field Demonstration for Feasibility and Cost Assessment
      a.   Develop scope / requirements, timeline, deliverables and budget for field demonstration of candidate technology(ies) packages that seamlessly integrate the actors to deliver VGI wholesale market services

Workstream 2: Technical
Deliverable 1: Map VGI Use Cases with existing Communication Protocols to Network Architectures – Standards Due Diligence
  a.   Referring to the ElaadNL Protocol Study, define the *Network Architecture(s)* necessary to enable the *VGI Use Cases* defined in the VGI Roadmap and Whitepaper, or additions of interest to participants. For what timeframes are these architectures applicable (e.g. vehicle model years, private charging infrastructure investments)?
  b.   Provide feedback on the appropriateness of the Exemplary Criteria in Appendix B to use for examination of *Communications Protocols*. If additional *Criteria* should be considered, specifically substantiate their addition by comparing their function to the VGI use cases defined and enabled in the network architectures or protocols identified above.

  Subgroup Focus Domains
  c.a. Which VGI use cases require communications between the Electric Vehicle (EV) and EV Service Equipment (EVSE)?
                          Which existing communication protocols apply to these use cases?
                      For which VGI use cases are communications between the EV and EVSE optional?
  d.b. Which VGI use cases require communications between the Charge Point Operator (CPO)Service Provider/Aggregator and the EVSE?
                      Which existing communication protocols apply?
                      For which VGI use cases are communications between the CPOService Provider/Aggregator and the EVSE optional?
  c.   Which VGI use cases require communications between the Service Provider/Aggregator and the EV?

> **Comment [DT2]:** The European chart figure 16 is not the appropriate starting point.
>
> We believe that many things in figure 16 are out-of-scope.
>
> Also Appendix B might be classified as objectives or possibly even business requirements that *may* be used to evaluate use cases but cannot be used to determine a protocol

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Which existing communications protocols apply?

For which VGI use cases are communications between the Service Provider/Aggregator and the EV optional?

e.   ~~Which VGI use cases require communications between the E-Mobility Service Provider (eMSP) and the Clearing House and the Charge Point Operator (CPO)?~~

iii. ~~Which existing communication protocols apply to these use cases?~~

iv. ~~For which VGI use cases are communications between the eMSP and the Clearing house and the CPO optional?~~

~~f.~~d. Which VGI use cases require communications between the Distribution System Operator (DSO) and ~~E-Mobility Service Provider (eMSP~~ Service Provider/Aggregator)?

Which existing communication protocols apply to these use cases?

For which VGI use cases are communications between the DSO and ~~O and~~ Service Provider /Aggregator ~~eMSP~~ optional?

Deliverable 2~~1~~: Analyze Opportunity Costs from Stakeholders' ~~Perspectiv~~Perspectivee~~s~~
~~(Refer to Straw Proposal Questions 1, 7)~~

a. Quantify the opportunity costs, per 1a and 1b, associated with the adoption or absence of the standard. If specific cost assumptions are unavailable, propose a framework for analysis.

~~a.~~b. If stakeholders have a recommendation whether the CPUC should require the utilities to specify a standard in their ratepayer-subsidized infrastructure, is there a consensus recommendation on the specification? If not, is there a ranking of the considered specifications?

~~Quantify the opportunity costs, per 1a and 1b, associated with the adoption or absence of the standard. If specific cost assumptions are unavailable, propose a framework for analysis.~~

~~Deliverable 3: Pilots and Field Demonstration for Feasibility and Cost Assessment~~

~~Develop scope / requirements, timeline, deliverables and budget for field demonstration of candidate technology(ies) packages that seamlessly integrate the actors to deliver VGI services~~

~~Quantify the opportunity costs, per 1a and 1b, associated with the adoption or absence of the standard. If specific cost assumptions are unavailable, propose a framework for analysis.~~

~~Validate and finalize the recommendation for consensus standard(s) that are equally viable and with the demonstration results as the justification for IOUs to use any of the viable packages for deployment of the ratepayer funded infrastructure.~~

Subgroup Focus Domains

~~a.~~a. For use cases that require a communication protocol between the EV and EVSE analyze the following from various stakeholder   perspectives:

    a. Evaluate the implications of requiring a *single* or requiring *multiple* communication protocols to be designed and operated between the EVSE and EV. How should this affect a utility's infrastructure investment? For both options, list pros, cons, tradeoffs, and mitigating factors.
   b. For use cases that require a communication protocol between the ~~CPO~~ Service Provider/Aggregator and the ~~EVSE analyze~~EVSE analyze the following from various stakeholder   perspectives:
      a. Evaluate the implications of requiring a *single* or requiring *multiple* communication protocols to be designed and operated between the CPO and EVSE. How should this affect a utility's infrastructure investment? For both options, list pros, cons, tradeoffs, and mitigating factors.
   c. For use cases that require a communication protocol between Service Provider/Aggregator and the EV ~~the eMSP and the Clearing House and the CPO~~ analyze the following from   various stakeholder perspectives:
      a. Evaluate the implications of requiring a *single* or requiring *multiple* communication protocols to be designed and operated between th Service Provider/Aggregator and the EV e ~~eMSP and Clearing House and CPO~~. How should this affect a utility's infrastructure investment? For both options,   list pros, cons, tradeoffs, and mitigating factors.
   d. For use cases that require a communication protocol between the DSO and Service Provider/Aggregator ~~eMSP~~ analyze the following from various stakeholder   perspectives:
      a. Evaluate the implications of requiring a *single* or requiring *multiple* communication protocols to be designed and operated between the DSO and ~~eMSP~~ Service Provider/Aggregator. How should this affect a utility's infrastructure investment? For both options, list pros, cons,   tradeoffs, and mitigating factors.

Meeting Trajectory

To assist working group participants' ability to schedule their participation and in consideration of the technical and multi-disciplinary nature of this task, the interagency staff propose that the working group meetings generally follow the following sequence:
1. Exposition of issue and proposals to solve problem, identification of preparatory items for in-person working session
2. In-Person workshop, alternating between San Francisco and Sacramento, stakeholder presentations, discussions and working sessions
   a. Follow-up in deliverable-specific subgroup break-outs working teams
3. Report-Out from Subgroups and Submission of Documents for Review
4. Feedback and Discussion, Resolution of Issue.

Identifier (Deliverable. Meeting#), Date, Location	Objective and Purpose Draft Agenda Topics	Needs Identified	Follow Up Assignments for Participants or Agencies	Applicable Excerpts from Supporting Documents
0.1 4/24/17 In-person San Francisco	• Introductions • Level setting • Present and receive Feedback on straw proposal • Initial identification of stakeholder interests in use cases and business	• Clearer understanding of scope • Clearer understanding of process • Common understanding of terms	• Sponsoring agencies will: • Present a work plan to WG • Identify foundation documents and research	• N/A
Deliverable 1: Map VGI Use Cases with existing Communication Protocols to Network Architectures				
1.1 5/15/17 Webex	• ElaadNL Presentation on EV Protocol Study • Feedback and agreement on work plan • Establish subgroup composition, form of deliverables, and communications and documentation	• Confirm and self-assemble subgroup teams and establish timeline for work deliverables • Participants propose for consideration other documents, definitions, or Criteria	• WG participants to: • Additional key definitions • Begin discussing Deliverables 1c, 1d, 1e, 1f in Subgroups • Presenters for 1a and 1b	• Protocol Study Sections 4, 5, Appendix B • VGI Whitepaper Part 2 and 3 • VGI Roadmap Section 2, 3.2, 3.3, 4.3 • Presentations from Research Reviews
1.2 5/30/17 Webex	• Agreement on terms and definitions • Presenters/Discussion on Network Architectures (1a) and Criteria (1b) • Subgroups present any major	•	• WG participants to: • Finalize key definitions, criteria • Continue subgroup dialogue in solving Deliverables 1c, 1d, 1e, 1f	• Appendix B Part 2

Comment [DT3]: This schedule needs modifying to accommodate the scope of work requests from the joint- utilities and the 8 automakers

	findings			
1.3 6/12/17 All Day Sacramento	• Finalize 1b • Subgroups present any divergence in positions on deliverables 1a, 1b, 1c, 1d, 1e, 1f • Working Session	• Participants supply evidence documents for positions on use cases, standards body roadmaps identifying timelines or technical differences	• <u>WG participants to:</u> • Begin outlining proposed findings, agreements, disagreements to be in draft solution for WG's consideration	•
1.4 6/26/17 Webex	• Present outlines and technical paths forward to resolve divergence in positions (if any) on 1c, 1d, 1e, 1f	• Participants supply evidence documents for positions on use cases, standards body roadmaps identifying timelines or technical differences	• <u>WG participants and agencies to:</u> • Identify gaps in past discussions • Prepare presentations or bring supporting documents to be discussed at next meeting	•
1.5 7/10/17 Webex	• Review and discuss subgroup recommendations • Finalize Deliverable 1c, 1d, 1e, 1f • Tee up discussion for Deliverable 2	• Participants self-identify where their company fits into each use case • Subgroups Draft Summary •	• <u>WG participants to:</u> • Complete Draft Summary of Deliverable 1 for WG's consideration • Develop presentations for opportunity cost analysis	•
Deliverable 2: Analyze Opportunity Costs from Stakeholders' Perspectives				
1.6 7/24/17 San Francisco	• Last technical discussion on Draft Summary document for Deliverable 1 • Kickoff Deliverable 2 • Presentations on Opportunity	• Confirm 4 subgroup teams and establish timeline for work deliverables	• Re-assemble into working teams and add market analysis to technical analysis completed in Deliverable 1	• Protocol Study Sections 6, 7, Appendix A • VGI Whitepaper Part 4 and 5 • VGI Roadmap Section 3.1, 4.2

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	Costs and discussion			• Appendix B • Presentations from Research Reviews
2.1 8/7/17 WebEx	• EVSE/EV Subgroup Presentation & Discussion • EVSE/CPO Subgroup Presentation & Discussion	• Participants supply evidence documents for positions on use cases, e.g. costs or expected market forecasts or product roadmaps	• Begin outlining proposed findings, agreements, disagreements to be in draft solution for WG's consideration	•
2.2 8/21/17 WebEx	• eMSP/Clearing House/CPO Presentation & Discussion • eMSP/DSO Presentation & Discussion	• Participants supply evidence documents for positions on use cases, e.g. costs or expected market forecasts or product roadmaps	• 4 subgroups begin preparing opportunity cost analysis for Deliverables 2a and 2b	•
2.3 9/4/17 WebEx	• Subgroups discuss outlines for analysis, discuss any divergence in positions on 2a and 2b	• Comments and positions on use cases • Identify Gaps in any past discussions	• 4 subgroups add Deliverable 2 opportunity cost analysis to technical analysis from Deliverable 1	•
2.4 9/18/17 Sacramento	• Subgroups present recommendations and opportunity cost analysis and discussion • Finalize Deliverable 2 • Agree to form of work product and mechanism for convening on Deliverable 3	• Subgroups Draft summary	• Complete Draft Summary of Deliverable 3 for WG's consideration • Initiate proposals for organization's actions to enable VGI value proposition and suggestions for policymakers • Prepare presentations on position for Deliverables 3.1 and related Questions	•

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Deliverable 3: Value Proposition and Enabling Policy			
3.1 10/2/17 Webex	• Stakeholders present on Deliverable 3.1 and related Straw Proposal questions	• Comments on positions on industry actions or policy • Supporting documentation	• Complete proposals on Deliverable 3.1	• Appendix B • VGI Whitepaper Part 5 • VGI Roadmap Section 4.2
3.4 10/16/17 San Francisco	• Stakeholders present on Deliverable 3.1 • Discuss any divergence in positions	• Draft Summary for Deliverable 3.1 for WG consideration	• Agencies compile recommendations and draft summary on Deliverable 3	•

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